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**UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF ILLINOIS
EASTERN DIVISION**

FILED
J N 07-31-07
JUL 31 2007
JUL 31, 2007
MICHAEL W. DOBBINS
CLERK, U.S. DISTRICT COURT

SENG-TIONG HO and YINGYAN HUANG,)	
)	
Plaintiffs,)	
)	
v.)	07CV4305
)	JUDGE BUCKLO
ALLEN TAFLOVE and SHIH-HUI CHANG,)	MAG. JUDGE NOLAN
)	
Defendants.)	
)	

COMPLAINT

Plaintiffs, Seng-Tiong Ho and Yingyan Huang, by and through their attorneys, Tressler, Soderstrom, Maloney & Priess, LLP, for their Complaint against Defendants Allen Taflove and Shih-Hui Chang state as follows:

INTRODUCTION

1. This action for copyright infringement, unfair competition, false designation of origin, trade secrets, conversion, fraud/misrepresentation, and for an accounting, is brought pursuant to the Copyright Act of 1976, 17 U.S.C. § 101 *et seq.*, several state statutes and under the common law. Plaintiffs assert these claims as a result of Defendants' use, copying and publication, without permission of the Plaintiffs' original text and works, including Seng Ho Notebook 98, Seng Ho Notebook 99, Yingyan Present 02, Yingyan Model Drawing, and Yingyan Thesis02 which were issued United States Copyright Certificates Nos. TXul-346-443, TXul-346-442, TXul-350-311, TXul-350-310 and TXul-351-143, effective March 16, 2007. Defendants, without Plaintiffs' permission, utilized portions of the aforesaid works and other works in Defendants' works that directly copied portions of Plaintiffs' works. In addition, Defendants have made certain false and misleading comments that, among other things,

designate Defendants falsely as the origin of Plaintiffs' works, etc., and advertise falsely to the public. Plaintiffs seek the full extent of relief available to them under the aforementioned law and an order directing the surrender of all infringing products for destruction, actual damages, including lost profits, the costs of this action, reasonable attorneys' fees, and for such other relief as to this Court may deem just, proper and equitable.

PARTIES

2. Plaintiff Seng-Tiong Ho is an individual residing in this judicial district. Ho is a Professor of Electrical Engineering at Northwestern University. Professor Ho has published many significant papers in atomic-field theory, Quantum Optics, semiconductors, photonics, computer simulations, and electromagnetics. Atom-field theory and Quantum Optics are central to the claims raised in this litigation.

3. Plaintiff Yingyan Huang is an individual residing in this judicial district. Huang was a graduate student in Electrical Engineering at Northwestern University in Professor Ho's laboratory who is known for his work in computational electromagnetics related to the subject matters raised herein.

4. Defendant Allen Taflove is an individual residing in this judicial district. Taflove is a Professor of Electrical Engineering at Northwestern University, who has done academic works but who has no prior publication(s) in Quantum Optics or atom-field theory.

5. Defendant Shih-Hui Chang was during the relevant time period an individual residing in this judicial district. Shih-Hui Chang was a post-doctorate research fellow at the Chemistry Department at Northwestern University and Argonne National Laboratory. Upon information and belief Chang is now working in Taiwan.

SUBJECT MATTER JURISDICTION AND VENUE

6. This Court has subject matter jurisdiction over the claims set forth in this Complaint pursuant to 15 U.S.C. § 1125, 17 U.S.C. § 106; 28 U.S.C. § 1338, 28 U.S.C. § 1400(a). As alleged above, Plaintiffs have made application and sent deposits to the United States Copyright Office, which issued certificates for copyrights in the aforesaid works of Plaintiffs.

7. Venue in this action lies within this Court pursuant to 28 U.S.C. §§ 1391 and 1400 as it is the residence of Plaintiffs, and as the judicial district which the events, acts or omissions giving rise to the claim occurred, including, but not limited, acts of infringement, and in which Defendants are subject to personal jurisdiction.

8. This Court has personal jurisdiction over Defendants pursuant to Rule 4(f) of the Federal Rules of Civil Procedure based, *inter alia*, upon the fact that Defendants transact business, committed unlawful acts within and live or lived within this judicial district during the relevant time period.

BACKGROUND

9. The 4-level 2-electron atomic model with Pauli Exclusion Principle for simulating the electron dynamics of active media using Finite Difference Time Domain (“FDTD”) method was first conceived and formulated by Professor Ho. Professor Ho conceived the idea in 1998 and wrote down the initial concepts in January 1999. This included the original formulation and full derivation of equations. The Principle involved two critical observations motivated by modeling semiconductor realistically for use in FDTD simulation, and is summarized in Professor Ho’s research notebooks for 1998 and 1999. After the initial conception, Professor Ho then derived all of the equations needed for the model in 1999, which involved 69 pages of notes

and equations. The FDTD computational model involving the 4-level 2-electron atomic system with Pauli Exclusion Principal for FDTD simulation formulated by Professor Ho was significantly different from any prior work, including that of A. S. Nagra and R. A. York in 1998. Professor Ho used a full quantum derivation for the medium based on quantum mechanical atom-field Hamiltonian to obtain a set of equations describing the dynamics for 2 electrons without the usual rotating-wave approximation. Professor Ho's formulation involved vector potential terms that allowed the treatment of both high-intensity and large frequency detuning from resonance, which often occur in devices. Professor Ho's notebook also contained various estimation of model parameters to be used for numerical simulation, including the estimation of dipole dephasing time of ~ 100 fsec at room temperature based on thermodynamic considerations and is generally applicable to systems with high dipole density such as in a semiconductor. The set of equations were in real variable form ready for use in numerical simulation.

10. The model was then implemented and validated with application to optical switching, gain medium, and lasing in collaboration with various research personnel in Professor Ho's group during 1999-2002. Professor Ho laid out the entire research program including various stages of development, which was Stage I of his research program. The computer program for the model simulation was adopted from an earlier FDTD program developed in Professor Ho's group from another one of Professor Ho's projects.

11. Shih-Hui Chang was a research assistant working with Professor Ho in 1998 and performed works directly under Professor Ho's instruction. During 1998-1999, Professor Ho first developed a standard FDTD program code with Shih-Hui Chang on a PC platform (RM.FDTD program code) The computational part of this code was based on the well-known

FDTD algorithm in the literature. The novel part of this program was only implementing the interface to PC-Corel-Draw commercially available software, which Ho and Chang co-developed. What was new in the program was the “PC-Corel-Draw software” based user interface. This interface was conceived by Professor Ho and was particularly efficient for inputting complex medium structure, which was needed for Professor Ho’s NSF-funded research project on studying lasing in randomly scattering medium.

12. After Professor Ho completed the derivation of all the equations, he then involved Shih-Hui Chang in co-implementing the new medium equations into the early RM-FDTD program code described above. Shih-Hui Chang took the equations from Professor Ho and put them into the program. However, Shih-Hui Chang was not able to get the program to work. In particular, the electron occupation number returned unphysical values for variables, which indicated errors in the programming. Professor Ho tried to guide Shih-Hui Chang in diagnosing the program but he expressed disinterest in doing so and doubted the equations from Professor Ho. In his first Ph.D. thesis proposal submitted in June 2001, Shih-Hui Chang did not present the key set of equations from Professor Ho.

13. Huang first entered Northwestern as a beginning M.S. student in Professor Ho’s laboratory in September 2000. In late 2000, Dr. Seongsik Chang (“Seongsik”), who was a postdoctoral fellow in Professor Ho’s group, picked up the development of the FDTD code for the 4-level 2-electron model with Pauli Exclusion Principle and later worked with Yingyan Huang. As Shih-Hui Chang’s medium code did not work, Seongsik and Yingyan Huang had to rewrite the code. After about 6 months, the first completely working program was achieved by Seongsik working with Yingyan Huang and was used to simulate a π -pulse (pi-pulse) switching problem. This program showed that a stable electron population could be achieved. This was an

important milestone in validating the feasibility of the model for numerical simulation. No previous model for FDTD numerical simulation had included more than one electron and Pauli Exclusion terms. The pi-pulse simulation was reported as a conference paper in the 2001 Annual Meeting of the Optical Society of America.

14. Later, during 2000-2001, Yingyan Huang, working with Seongsik Chang under Professor Ho's guidance, investigated the application of the new 4-level 2-electron model with Pauli Exclusion Principle to a gain or a lasing medium. The main focus was to show the working of Professor Ho's new model for a wide range of gain medium parameters, including the region of low to medium dipole density of a quantum well or bulk semiconductor media, as well as the region of high dipole density in which super-radiance could be observed, thereby fully validating Professor Ho's new model for application to a gain or a lasing medium across a wide range of operating conditions. This work fully validated Professor Ho's model under FDTD simulation with substantial data, with more fundamental testing than their paper as Plaintiffs explored a wide range of atomic density and light intensity and carefully examined the gain's temporal behaviors.

15. Plaintiffs' works were originally developed through their own ideas and expression, and were reduced by Plaintiffs to a tangible medium of expression, namely written text. Professor Ho's research results were partially published in a conference paper in 2001 and then published in more detail in 2002 in Yingyan Huang's thesis under Ho's permission. See Ex. B, "THz All-Optical Shutter based on Semiconductor Transparency Switching by Two Optical π -Pulses", Seongsik Chang, Yingyan Huang, Shih-Hui Chang, and Seng-Tiong Ho, 2001 Technical Program for the Annual Meeting of the Optical Society of America, Long Beach, CA, 16 October, 2001, and Ex. C, "Simulation of Semiconductor Materials Using FDTD Method,"

Yingyan Huang, Master's Thesis, Northwestern University, May 2002 (Northwestern University Library call number Diss 378 NU 2002 H8743s).

16. Plaintiffs are, in whole or in part, the authors, owners and/or creators of the various works hereinabove mentioned, claim ownership to copyrights in the various works, and have taken appropriate measures to protect their copyrights and place the public on notice thereof, including the registration of said works with the United States Copyright Office.

DEFENDANTS' UNLAWFUL PRACTICES

17. Yingyan Huang gave a presentation of her results at the Physics Department of Northwestern University on January 15, 2002 to Professor Hui Cao's group. Shih-Hui Chang was present during the presentation. Yingyan Huang's results were later summarized in her Master's Thesis presented in May 2002. Using the validated model, Yingyan Huang also did a 2-D simulation of a novel nanolaser structure in mid-2002 and performed experimental verification. After Shih-Hui Chang attended Yingyan Huang's presentation on January 15, 2002, Shih-Hui Chang became somewhat interested in the 4-level 2-electron model with Pauli Exclusion Principle. Professor Ho gave Shih-Hui Chang permission to include this model in Shih-Hui Chang's January 29, 2002 draft of Shih-Hui Chang's second Ph.D. thesis proposal. In this second Ph.D thesis proposal, Shih-Hui Chang only proposed the use of the model to random medium lasing and gave no simulation result. In this second proposal Shih-Hui Chang had also copied relevant figures from Yingyan Huang's presentation, which he further reproduced in his 2003 Ph.D thesis, his 2003 IEEE-APS paper, and his 2004 Optics Express paper.

18. In or around June 2001, Shih-Hui Chang prepared his first Ph.D thesis proposal presentation in Professor Ho's group. This thesis proposal did not have the 4-level 2-electron model with Pauli Exclusion Principle. The model he had was a simple system for optical

pumping. This reflected the fact that Shih-Hui Chang did not originate the model nor had much interest in the model then. After Shih-Hui Chang's presentation, Professor Kumar raised concern about Shih-Hui Chang's weakness in presentation and writing, and asked that his proposal be revised. On January 11, 2002, before he attended Yingyan Huang's presentation on January 15, 2002, Shih-Hui Chang emailed Professor Ho an initial draft copy of his revised second thesis proposal. The relevant part was very similar to his June 2001 version, again without the 4-level 2-electron model with Pauli Exclusion Principle. The final draft of Shih-Hui Chang's second thesis proposal in late January 2002 contains Professor Ho's model. Upon information and belief, Shih-Hui Chang, with Taflove listed as his supervisor, used Plaintiffs' works in his thesis in June 2003. This allowed Chang to graduate earlier and begin earning income earlier. Also, upon information and belief, Shih-Hui Chang and Taflove co-published Plaintiffs' works in a conference paper in June 2003, which enabled Taflove to be recognized for originating Plaintiffs' formulations, and thereby gain publication citations and career advancements.

19. In May/June 2002, Shih-Hui Chang informed Professor Ho that he wanted to join Taflove's group as he wanted to change to do 3D FDTD. Shih-Hui Chang was then advised by Professor Kumar (Head of Northwestern's Photonics Group) at that time that he should not continue his previous works in the new group to avoid conflicts.

20. There was to be a journal publication in 2004 of Plaintiffs' works, at which time Defendants' wrongful conduct was discovered. In August 2004 Defendants' article entitled "Finite-difference time-domain model of lasing action in a four-level two-electron atomic system" ("the Article") was published in the Optics Express journal. The Article identified the new contributions of the Article as being the new FDTD computational model of a gain medium

involving a four-level two-electron system with Pauli Exclusion Principle governed by a specific set of rate equations. Defendants described this model as an advance relative to earlier FDTD models that did not include the pumping dynamics or the Pauli Exclusion Principle. What Defendants claimed to be new in their paper included:

- a. The concept and specific formulation of a new FDTD computational model involving a 4-level 2-electron system for the pumping dynamics and Pauli Exclusion Principle enabling the simulation of a gain medium with two interacting electrons. The key concept here is the involvement of two electrons and the incorporation of the right Pauli Exclusion terms in the rate equations so that only one electron can occupy each quantum state. The set of about 20 equations at pages 2-4 of the Article uniquely formed the central formulation for the model. This set of 20 equations described what Defendants referred to as their new model and its derivation. If one were to compare the equations describing their model to Nagra's paper, one will find that what are new in this set of equations, which forms the key features of the model, including:
- b. It is a quantum derivation instead of the classical derivation of Nagra's paper, a reference cited by Defendants in their infringing paper.
- c. It involved Pauli Exclusion terms in Eq. 10 & Eqs. 11a-11d not in Nagra's paper.
- d. It involved 2 electrons and 4 levels described in Eqs. 11a-11d not in Nagra's paper.
- e. The application of the model to medium with electron dynamics in the energy levels.
- f. It involved vector potential terms (Eqs. 4-8), in particular an A-square term in Eqs. 6-8, making it valid for large electric field. These terms are not in Nagra's paper.

In the Results section, the Article showed:

- g. What they claimed to be the first illustration of the FDTD simulation of the model using a laser device with a gain medium (taken into account dipole dephasing with τ_{32} and τ_{10} of 100 fsec) as the first validation of the model.

These seven elements labeled as (a) through (g) above clearly expressed by Defendants as the significant elements in the Article. Upon information and belief these significant elements are the reason why the Article was accepted for publication.

21. Defendants have utilized, copied and unlawfully appropriated, without attribution, permission or notice to Plaintiffs, portions of Plaintiffs' copyrighted works as noted above. Defendants plagiarized all of the significant elements of Plaintiffs' works. The Article claimed that Defendants introduced a new model, which in reality is exactly the same as the model Plaintiffs had formulated, developed, presented, and published in 1998-2002. Specifically, the plagiarized parts include but are not limited to the following:

- (1) The modeling concept of using four-level two-electron atomic system with Pauli Exclusion Principle for FDTD simulation.
- (2) The entire formulation involving all of the equations.
- (3) The steps of deriving all of the equations (the 20 equations on pages 2-4 forming the entire formulation of their model).
- (4) The application of the new model to modeling gain or lasing medium.
- (5) The application of the new model to modeling atomic-level medium with dipole dephasing.
- (6) The application of the new model to modeling atomic-level medium with two electrons in a four-level system.
- (7) Defendants' claimed validation of the new model while they knew that Plaintiffs' previous works already studied the modeling of gain medium and already achieved extensive simulation results to validate the model, including the medium parameter space used in their simulation.

22. Defendants also submitted a long 4-page symposium paper (titled "Four-Level Two-Electron FDTD Model of Lasing Action in a Semiconductor,") to IEEE APS, which is an archival publication available online. The IEEE paper claimed semiconductor instead of atomic medium and yet had exactly the same simulation example and medium parameters as the Article

claiming atomic medium. The IEEE paper listed Professor Hui Cao as co-author without her consent. In this paper, the plagiarized parts further include:

- (1) The application of the new model to modeling semiconductor medium.
- (2) The application of the new model to modeling semiconductor medium with dipole dephasing.
- (3) The application of the new model to modeling electron dynamics in the conduction and valence bands of a semiconductor.

23. Defendants also subsequently published a book chapter in a book titled “Computational Electrodynamics: The Finite-Difference Time-Domain Method (third edition)” with authors Allen Taflov and Susan Hagness in the cover page in 2005 and a co-author Shi-Hui Chang in Chapter 9 of this book. The book chapter claimed a detailed formulation with exactly the same 4-level 2-electron medium and application to semiconductor. Even after Plaintiffs notified Defendants in November/December 2004 that Defendants infringed Plaintiffs’ works, Defendants have continued to willfully infringe said works in this published book chapter.

FIRST CAUSE OF ACTION
(COPYRIGHT INFRINGEMENT)

24. Plaintiffs repeat and reallege the allegations contained in paragraphs 1 through 23 of this Complaint as if more fully set forth herein.

25. Plaintiffs created original works of authorship embodied in the original works set forth above.

26. The aforementioned works were originally authored by Plaintiffs, and consist of copyrightable subject matter under the laws of the United States, as evidenced by the copyright certificates issued therefore.

27. At all times hereinbefore mentioned, Plaintiffs, in whole or in part, have complied with the Copyright Act and all other laws governing copyrights, and have secured and maintained the exclusive rights and privileges in and to the copyrights of the aforesaid works, and have received from the United States Registrar of Copyrights Certificates of Registration.

28. At all times, Plaintiffs have been and still are the owner of all rights, title and interest in and to the copyrights of said works.

29. Defendants have infringed said copyrights by publishing and claiming as their own the Article hereinabove noted, which was copied, in whole or in part, from Plaintiffs' copyrighted works.

30. Plaintiffs have notified Defendants that Defendants have infringed Plaintiffs' copyrights, but Defendants have continued to willfully infringe said copyrights.

31. The reproduction, preparation of derivative works, and public display by Defendants of Plaintiffs' copyrighted works constitute violations of Plaintiffs' exclusive rights as copyright owners under the Copyright Act, and thus constitute copyright infringement.

32. Plaintiffs allege that Defendants' infringements were knowing and willful, and represent a calculated attempt to profit from Plaintiffs' copyrighted works, without permission.

33. Plaintiffs are, therefore, entitled to the relief available under the Copyright Act, including, but not limited to, a Preliminary and Permanent Injunction an injunction ordering Defendants to withdraw each and every paper and book that contains the four-level two-electron model with Pauli Exclusion Principle and to cease claiming this model as Defendant's original work, restraining Defendants, and those acting in concert with them, from committing further infringements, actual damages, reasonable attorney's fees, costs of this action and such other and further relief as to this Court seems just, proper and equitable.

SECOND CAUSE OF ACTION
(FALSE DESIGNATION OF ORIGIN)

34. Plaintiffs repeat and reallege the allegations contained in paragraphs 1 through 33 above as if fully set forth herein.

35. As a result of Defendants' use of Plaintiffs' works and failure to provide any attribution to Plaintiffs, Defendants have caused and are likely to continue to cause confusion or to cause mistake or to deceive the public as to the origin of the subject works in violation of the Lanham Act, 15 U.S.C. § 1125.

36. By reason of Defendants' acts, Plaintiffs have suffered and will continue to suffer damage and injury to their business, reputation and goodwill and have and will continue to sustain substantial loss of revenues and profits.

37. Unless enjoined by this Court, Defendants will continue to perform the acts complained herein and cause said damages and injury, all to the immediate and irreparable harm of Plaintiffs. Plaintiffs have no adequate remedy at law for Defendants' wrongful acts.

THIRD CAUSE OF ACTION
(UNFAIR COMPETITION)

38. Plaintiffs repeat and reallege the allegations contained in paragraphs 1 through 37 above as if more fully set forth herein.

39. Upon information and belief and at various times, Defendants have been misrepresenting to publishers (*i.e.*, Optics Express, IEEE-APS and the book publisher) that the content of Defendants' manuscript is the original work of the Defendants. Based on that misrepresentation, Optics Express, IEEE-APS, and the book publisher Artech House then published, distributed, sold and otherwise marketed the infringing works. Defendants have thereby been engaging in unfair and deceptive trade practices by palming off the infringing

works as original works, and in many respects, by characterizing themselves as authors, creators and the like, none of whom, at least to the extent of the infringing works, created such.

40. By reason of Defendants' unfair competition, Plaintiffs have suffered and continue to suffer irreparable damage.

FOURTH CAUSE OF ACTION
(CONVERSION)

41. Plaintiffs repeat and reallege the allegations contained in paragraphs 1 through 40 above as if more fully set forth herein.

42. Although Defendants had full knowledge that the Plaintiffs' works were solely the property of Plaintiffs, Defendants misappropriated the works by publishing said works and text in the Article as aforesaid, and Defendants passed off said works and text as their own without giving credit to Plaintiffs or in any way acknowledging the fact that said works and text are solely the property of Plaintiffs.

FIFTH CAUSE OF ACTION
(FRAUD/MISREPRESENTATION)

43. Plaintiffs repeat and reallege the allegations contained in paragraphs 1 through 42 above as if fully set forth herein.

44. When they submitted the Article for publication, Defendants knew they were not the original authors of the ideas in the Article.

45. That despite such knowledge, and with intent to obtain an unfair advantage, Defendants fraudulently represented that they were the original authors of said works.

46. That as a result of said misrepresentations, Plaintiffs have been irreparably damaged.

SIXTH CAUSE OF ACTION
(MISAPPROPRIATION OF TRADE SECRETS)

47. Plaintiffs repeat and reallege the allegations contained in paragraphs 1 through 46 above as if fully set forth herein.

48. Plaintiffs' subject works constitute trade secrets.

49. By the acts set forth above, Defendants misappropriated Plaintiffs' trade secrets.

50. As a direct and proximate result of Defendants' misappropriation, Plaintiffs have been damaged.

SEVENTH CAUSE OF ACTION
(ACCOUNTING)

51. Plaintiffs repeat and reallege the allegations contained in Paragraphs 1 through 50 above as if fully set forth herein.

52. As a consequence of Defendants' copyright infringement, conversion, fraud, unfair competition, false designation of origin, misappropriation of trade secrets, and other unlawful acts, Plaintiffs are entitled to an accounting from the Defendants for all gains, profits and advantages derived by Defendants from its publication, license, distribution and sale of the Article, along with other unlawful activities, and upon such an accounting, that Defendants pay over to Plaintiffs damages and/or all such sums derived by way of profits from the publication, license, distribution, sale and other disposal of such infringing material.

JURY DEMAND

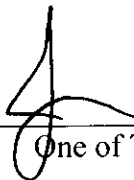
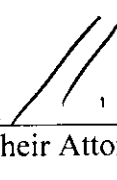
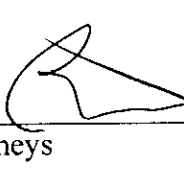
Plaintiffs demand trial by jury.

PRAYER FOR RELIEF AS TO ALL COUNTS

WHEREFORE, Plaintiffs Seng-Tiong Ho and Yingyan Huang respectfully request that this Court enter judgment in their favor and against Defendants Allen Taflove and Shih-Hui Chang for the amount of damages to be proven at trial, punitive damages, plus preliminary and

permanent injunctive relief, interest, attorneys' fees, costs and for such further relief as this Court deems just and appropriate.

SENG-TIONG HO and YINGYAN HUANG

By:    _____
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